SCIENCE

NEW YORK, MARCH 27, 1891.

THE OYSTER QUESTION.[1]

I HAVE been asked to say a few words on the relation of scientific investigation to the great question of the preservation of the Maryland oyster. It is Professor Brooks who ought now to be addressing you, for it is chiefly concerning his work that I shall have to speak. It is nearly all of it his work; but he would not have said this himself, and for that reason, at least, I am glad to stand in his shoes to-day. It is a simple tale I have to tell. If at its close I try to point a moral, you will kindly hold me alone responsible for what I may say. No other person has at the present moment an inkling of what it is to be.

In 1879 there appeared a modest pamphlet, No. 1, of the "Studies from the Biological Laboratory of the Johns Hopkins University." Among other papers, it included one by Professor Brooks, on the development from the egg of a small animal, which, details apart, I may designate as a third or fourth or Virginian cousin of the oyster: at any rate, it and the oyster belong to the same great molluscan group of animals. This work was done in 1878. It was followed next year by a treatise on the development of some fresh-water *Mollusca;* and during the same year another member of the university endeavored, at the instigation of the Fish Commission, to discover the very youngest oysters, and learn their mode of life; to find how they grew, what they needed, and what they did, what they thrived on, and what was apt to injure them until they settled down on the bottom of our bay to fatten for Baltimore palates.

This first effort was a failure, in consequence of too great reliance upon the natural history of the oyster of the effete monarchies of the Old World. The oyster of Europe is a molly-coddled youngster, living inside his mamma's shell until he has a shell of his own. Seeking the young American oyster between the shells of its mother, Professor Rice failed to find it, as others had failed before. In the early spring of 1879, Major Ferguson, then fish commissioner of Maryland, made another appeal to Professor Brooks, and offered him aid not only from the State, but from the National Fish Commission, in order that he might study the development and life-history of the oyster. For such a study his work on the early development of other *Mollusca* had fitted him. The university trustees gave him leave of absence more than a month before the beginning of the regular holiday. Some of his colleagues assumed responsibility for due performance of the regular academic work. He went to Crisfield, where he was later in the season joined by other members of the biological department of the university.

Within twenty-four hours of the arrival of Dr. Brooks at Crisfield, two facts of fundamental importance were discovered by him, — one that the American oyster is not nursed within the shell of the parent, but, like all young Americans, shows an early independence; the other, that it was possible to take their eggs from oysters, and fertilize and rear them artificially, just as shad and trout are bred in our great fish-cultural stations on the Susquehanna and elsewhere. These two discoveries, based on previous investigation of the development of mollusks which had no commercial importance, made a new starting-point for the study of the oyster. It was impossible to catch and study in continuous development the microscopic, embryonic oyster scattered throughout the Chesapeake Bay; but once we could hatch out the oyster in the laboratory, and study its growth and life conditions, a very important step forward would be made. It was proved that we could get young oysters in incalculable numbers at a very small cost; and, far more important, an opportunity to investigate the life conditions of the young oyster would be given. To carry on the growth of the artificially hatched young oysters, a steady supply of fresh sea-water was needed. This the university provided the next year by the purchase of a small steam-engine and a complete outfit for the breeding of young oysters on a small scale. The privations endured by the morphologists of the biological laboratory in the endeavor to find out the whole life-history of the Chesapeake oyster at every stage of its growth, to find its enemies, and how to meet and beat them, were not inconsiderable. Being cast adrift on a barge on the bay during a storm was but one of their anxieties.

The seaside laboratory of the Johns Hopkins University maintained its station at Crisfield until early in July; then the men had to leave. Biologists are human, and the Crisfield mosquito is inhuman; and some rather extravagant persons assert, that, should the present state of affairs continue, the average Crisfield oyster will soon be no larger than the average Crisfield mosquito. But before the party left, they had established the two leading facts, — that the eggs of the Maryland oyster are thrown out into the bay to be fertilized at random, and that it was possible to fertilize and hatch thousands of them in a watch-glass; in fact, that in a few buckets of sea-water one could hatch enough eggs to supply spat for the whole Chesapeake Bay.

And what does that bay mean? Honestly and intelligently managed, it means untold wealth for our State. The people of Maryland have a richer heritage than the coal-fields of Pennsylvania or the silver mountains of Colorado. The two latter may, they must, become exhausted as time goes on; while, with some little wise and faithful care, the Chesapeake will bring, year after year, millions of dollars to Maryland citizens. This may seem an extravagant statement; but, if you will consider the facts, you will find that it is but sober truth.

Have you any notion of the wealth that is carried down to the Chesapeake by the rivers that flow into it? You have seen our oyster soiled by black mud, which surrounds its shells. Did you ever think what that mud meant? It is the nesting-place of the food of the oyster. This food consists of tiny plants, which find nourishment in the mud, and multiply with inconceivable rapidity.

How the oyster feeds may seem a problem. Fixed to an anchorage, how does it get its food? As seen on the "raw box," which is always "now open," the oyster is shut as close as a clam; but in its native habitat its shells are always a little apart, and microscopic waving hairs set up currents which carry the food-plants to its mouth, where they are ingulfed and afterwards digested. The oyster feeds every hour, every minute, of the day, and turns material otherwise unavailable into one of the best of human foods. Scientific work by the State and national surveys has proved that nearly three-quarters of the bay are covered by such mud, and are fitted to nourish oysters, though only a small part is oyster-bed. Why? The embryo sinks in the mud, and is smothered. To thrive, it needs merely some stones or other solid objects to serve as a resting-place.

It might seem that an increase of oysters would exhaust this supply of mud food, as the cattle of our Western ranges exhaust the bunch-grass; but the supply is inexhaustible. This mud swarms with the germs of little plants, which swim through the water, and are taken in by the oyster. It is impossible to exhaust the food-supply of the oyster; and you do not have to provide it, like the Kansas farmer, who has to grow corn and turn it into pork.

We have, then, two questions confronting us, — the preservation of our existing oyster-beds, and the making of new ones. For

[1] Address by Dr. H. Newell Martin, professor of biology, at the fifteenth anniversary of the Johns Hopkins University, Feb. 23, 1891.

the making of new oyster-beds, legislation is necessary, in order that citizens may spend the money necessary to prepare and sow them, and that they may feel sure that their investment shall be protected from theft. As to protection from theft, I am informed, on what I believe to be good authority, that a private oyster-bed, made in accordance with full provisions of the law, was robbed of 340,000 bushels of oysters last season, with no effective interference from the oyster navy.

This navy, what is it? and our laws, what are they?

Let me tell you a short story, but a true one, — a story of an oyster-steamer with some scientific students on board. On every side dredgers were violating the law. About dark each day the captain felt sufficiently braced up to make an arrest: he made for the nearest oyster-sloop, quite sure that it was breaking the law; and, as every oyster-sloop does violate the law, the captain was safe in going for the nearest. The commander of the pirate was arrested and taken before a justice of the peace, who had his office near the place of arrest. The magistrate, more likely than not a shareholder in the oyster-stealing sloop, was asked to wait until the accused person could bring his witnesses. The outraged captain answered that he could not waste the time of his scientific friends, and he therefore withdrew the charge, that they might not suffer; and this sort of thing went on day after day.

Is not this oyster navy, on the whole, a fraud, or perhaps rather a sham, — the scoff of the oyster thieves and the scorn of the whole State? Perhaps not so bad as it used to be, but even now a public scandal.

Some friends wish the university to undertake the breeding of oysters. That is purely a commercial matter, and should be done by business-men. The engagement of the proper man as manager, the hiring of laborers, the purchase of machinery, — all that is a business matter, and not university work at all.

They say, "We want to get the oyster out of politics." The university cannot take it out, though the oyster might get the university into politics, which may a merciful Providence forever forefend! You cannot get the oyster out of politics, and it would not be right to do it if you could. As oyster-catching is a chief industry of the State, the oyster question must always be a political question. The one thing necessary is to make our politicians as good as our oysters.

The fact remains that the Maryland oyster is becoming extinct. To preserve it, to maintain our heritage, needs some little honest and intelligent legislation, needs some active, instructed, and well-meaning control. Will you see to it?

RECENT ADVANCES IN MEDICINE.[1]

EMANCIPATED from the thraldom of authority in which it was fast bound for centuries, medicine has progressed with extraordinary rapidity, and even within the present generation has undergone a complete revolution. The advance has been in three directions: first, in the prevention of disease. A study of the conditions under which epidemics develop has led to the important work of sanitary science. For fifty years the watchword of the profession in this matter has been cleanliness; and clean streets, good drains, and pure water have in many towns reduced the mortality from certain diseases fifty per cent. In this department certainly medicine has achieved its greatest victories. It is a thought full of encouragement to know that such diseases as typhoid-fever and diphtheria may ultimately be stamped out, and be as rare among us as leprosy and small-pox. In this work the profession requires, and can often obtain, the intelligent co-operation of city authorities and the public. People scarcely understand how much has already been done, nor do they yet fully appreciate the possibilities of preventive medicine.

The second great advance which medicine has made relates to the knowledge which has been gained of the agents producing diseases. Dating from the studies on fermentation by Pasteur, and the early work of Lister, we have gradually learned to recognize the importance of the structures known as bacteria, which has revolutionized the practice of surgery and gynecology. To-day surgery is a new art, and hundreds now recover after operations from which hundreds previously died. The information which we now have on these subjects has been slowly and painfully acquired, here a little and there a little; but the outcome of it all is that as clean streets and good drains and pure water mean municipal health, so absolute cleanliness and absence of contamination mean in great part freedom from infection. So universally present are the infective agents, particularly of suppuration, that it is only by the most scrupulous care that the infection of wounds can be prevented; and it is now generally acknowledged that the highest type of this antisepticism is obtained, not by the use of various solutions which destroy the germs, but by such measures of cleanliness as effectually prevent the possibility of their presence. Now, the point for the public to appreciate in this whole question is that they are reaping the benefit of advances rendered possible by work done in laboratories without a thought of its application to life-saving.

The researches showing the relation of special microscopic organisms to special diseases are likely to lead to the most important results. The cultivation of the germs of disease outside of the body has enabled us to study the products of their growth, and in several instances from them to obtain materials which, when injected into an animal, act as a sort of vaccine against the disease itself. The hope of obtaining in some of the most important diseases vaccines which will bear the same relation to them as ordinary vaccine to small-pox is very reasonable, and likely ere long to be realized. In another direction, too, the recent studies of Koch have shown that in the growth of these bacilli materials are obtained which may act most powerfully upon the body, and attack the elements of the disease itself. His discovery of the action of the product of the growth of the tubercle bacilli upon tuberculous tissue ranks as one of the most remarkable of late years. His claims that this will cure early tuberculosis and lupus will, I believe, be substantiated. Great as is this fact in itself, the possibilities which it opens up to our view are still greater, and it may be safely said, that, apart altogether from the action of the lymph, no more encouraging discovery has been made in the past twenty-five years.

But I hear the householder say, "All that is very well; but Tommy gets the measles, and Mary has the mumps, and Susie gets the whooping-cough, just as my grandmother tells me her children had fifty years ago. My doctor's bills are possibly a little larger than were father's, and I know his drug bill could not have been as heavy as was mine for the last quarter." This may be perfectly true, for the millennium has not yet come; but it is perfectly true that to-day Mrs. Householder's risks have been reduced to a minimum in the necessary domestic emergencies, and her children's chances of reaching maturity have been enormously enhanced.

The third great advance has been the diffusion in the profession and among the public of the more rational ideas upon the treatment of disease. Dieting and nursing have supplanted in great part bleeding and physicking. We know now that a majority of febrile affections run a definite course, uninfluenced by drugs. We recognize daily the great fact that disease is only a modification of the normal processes of health, and that there is a natural tendency to recover. We cannot claim in the medicinal treatment of disease to have made great positive advances; still, to have learned not to do what we did is for the poor patients a great gain. The past half-century has placed only half a dozen absolutely indispensable drugs which must be used by all indiscriminately who practise the healing art.

A desire to take medicine is, perhaps, the great feature which distinguishes man from other animals. Why this appetite should have developed, how it could have grown to its present dimensions, what it will ultimately reach, are interesting problems in psychology. Of one thing I must complain, — that when we of the profession have gradually emancipated ourselves from a routine administration of nauseous mixtures on every possible occasion, and when we are able to say, without fear of dismissal, that a little more exercise, a little less food, and a little less tobacco and alcohol, may possibly meet the indications of the case — I say it is a just cause of complaint that when we, the priests, have

[1] Address by Dr. William Osler, professor of medicine, at the fifteenth anniversary of the Johns Hopkins University, Feb. 23, 1891.

left off the worship of Baal, and have deserted the groves and high places, and have sworn allegiance to the true god of science, that you, the people, should wander off after all manner of idols, and delight more and more in patent medicines, and be more than ever at the hands of advertising quacks. But for a time it must be so. This is yet the childhood of the world, and a supine credulity is still the most charming characteristic of man.

Some of the brightest hopes of humanity are with the medical profession. To it, not to law or theology, belong the promises. Disease will always be with us, but we may look forward confidently to the time when epidemics shall be no more, when typhoid shall be as rare as typhus, and tuberculosis as leprosy. Man, naturally a transgressor daily, both in ignorance and deliberately breaking the laws of health, will always need doctors; but the great group of preventable diseases will disappear. The progress will be gradual. What has been done is but an earnest of the things that shall be done. Amid many disappointments, we must not be impatient, as "science moves but slowly, slowly creeping from point to point."

BAUXITE IN ARKANSAS.[1]

THE Geological Survey of Arkansas has discovered deposits of bauxite in that State, the first considerable ones thus far found in this country. In 1887 a small deposit was discovered in Floyd County, Ga., but that is said to cover "an area of about half an acre" only.[2]

The Arkansas beds occur near the railway in the vicinity of Little Rock, Pulaski County, and near Benton, Saline County. The exposures vary in size from an acre to twenty acres or more, and aggregate something over a square mile. This does not, in all probability, include the total area covered by bauxite in the counties mentioned, for the method of occurrence of the deposits leads to the supposition that there are others as yet undiscovered by the survey.

In thickness the beds vary from a few feet to over 40 feet, with the total thickness undetermined. The average thickness is at least 15 feet.

These Arkansas deposits occur only in tertiary areas and in the neighborhood of eruptive syenites ("granites"), to which they seem to be genetically related. In elevation they occur only at and below 300 feet above tide-level, and most of them lie between 260 and 270 feet above tide. They have soft tertiary beds both above and below them at a few places, and must therefore be of tertiary age. As a rule, however, they have no covering, the overlying beds having been removed by erosion, and are high enough above the drainage of the country to be readily quarried. Erosive action has removed a part of the bauxite in some cases; but there are, in all probability, many places at which it has not yet been even uncovered.

It is pisolitic in structure, and, like all bauxite, varies more or less in color and in chemical composition. At a few places it is so charged with iron, that attempts have been made to mine it for iron ore. Some of the samples from these pits assay over 50 per cent of metallic iron. This ferruginous kind is exceptional, however. From the dark-red varieties it grades through the browns and yellow to pearl-gray, cream-colored, and milky white; the pinks, browns, and grays being the more abundant. Some of the white varieties have the chemical composition of kaolin; while the red, brown, and gray have but little silica and iron, and a high percentage of alumina. The analyses given below show that this bauxite is as good as that of France, Austria, and Ireland, for the manufacture of chemical products, for refractory material, and for the manufacture of aluminum by the Deville process. Should there be a market in this country for such material, Arkansas will be able to supply any demand that may be made for it. No use has ever been made of the Arkansas material except for road-building: indeed, it was not known what it was until January last, when the announcement was made by the State geologist in a letter to the governor.

Partial Analyses of Bauxite from Arkansas.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Alumina	55.59	57.62	58.60	55.89	44.81	62.05	55.64	51.90
Silica	10.13	11.48	3.34	5.11	33.94	2.00	10.38	16.76
Ferric oxide	6.08	1.83	9.11	19.45	1.37	1.66	1.95	3.16
Titanic oxide					2.00	3.50	3.50	3.50
Loss on ignition (water)	28.99	28.63	28.63	17.39	17.28	30.31	27.62	24.86

Average of Fourteen Partial Analyses of Bauxite from France, Austria, and Ireland.[1]

Alumina	52.7 per cent.
Silica	7.1 " "
Ferric oxide	19.1 " "
Water	16.4 " "

The above analyses made by the State Geological Survey show the composition of average samples.

REMOVING TASSELS FROM CORN.

EXPERIMENTS with strawberries made at the Ohio Experiment Station indicate that pollen-bearing is an exhaustive process, and that larger yields of fruit, as a rule, may be expected from those varieties which produce pollen so sparingly that a small proportion of other varieties producing pollen abundantly must be planted with them in order to insure a full crop, than from those which produce sufficient pollen for self-fertilization.

The following very interesting and valuable experiment on corn, made by the experiment station of Cornell University, at Ithaca, N.Y., gives strong support to this theory.

It has been claimed that if the tassels were removed from corn before they have produced pollen, the strength thus saved to the plant would be turned to the ovaries, and a larger amount of grain be produced. To test the effect of this theory, the following trial was made during the past season.

In the general cornfield a plot of forty-eight rows, with forty-two hills in each row, was selected for the experiment. From each alternate row the tassels were removed as soon as they appeared, and before any pollen had fallen. The remaining rows were left undisturbed. The corn was Sibley's Pride of the North, planted the last week in May in hills three feet six inches by three feet eight inches, on dry, gravelly, moderately fertile soil.

On July 21 the earliest tassels began to make their appearance in the folds of the upper leaves, and were removed as soon as they could be seen, and before they were fully developed. A slight pull was sufficient to break the stalk just below the tassel, and the removal was easy and rapid.

On July 25 the plot was gone over again for the removal of such tassels as had appeared since the previous work, and at this time by far the greater number of the tassels were removed.

On July 28, when the plot was gone over the third time, the effects of the tasselling became apparent in the increased number of silks that were visible on the rows from which the tassels had been removed.

On the 1,008 tasselled hills there were visible 591 silks; on the 1,008 untasselled, 393 silks.

On Aug. 4 the plot was gone over for the last time, but only a few tassels were found on the very latest stalks. The preponderance of visible silk on the tasselled rows was still manifest, there being at this time 3,542 silks visible on the tasselled rows, and but 2,044 on the untasselled rows. The corn was allowed to stand without cutting until ripe.

[1] By John C. Branner, Ph.D., State geologist of Arkansas (American Geologist, March, 1891).

[2] Transactions of the American Institute of Mechanical Engineers, xvi. p. 905.

[1] From analyses principally by Saint-Claire Deville given in the Ann. de Chimie et de Physique, lxi. 1861, p. 309 et seq.; Bull. Soc. Geol. de France, xvi. 1888, p. 345; Dingler's Polytechnisches Journal, 198, p. 156, and 234, p. 465; Bischof's Feuerfesten Thone, p. 194; Percy's Metallurgy, p. 133.

Sept. 29 to Oct. 1 the rows were cut and husked, and the stalks and ears weighed and counted, with the following results: —

	Aggregate Yield.		Comparative Yield.	
	Tassels left on.	Tassels removed.	Tassels left on.	Tassels removed.
Number of good ears	1551	2338	100	151
Number of poor ears	628	885	100	141
Number of abortive ears	2566	951	100	37
Total number of ears	4745	4174	100	88
Weight of merchantable corn (pounds)	710	1078	100	152
Weight of poor corn (pounds)	130	187	100	144
Number of stalks	4186	4228	100	101
100 stalks weighed (pounds)	82	79	100	96

It will thus be seen that the number of good ears and the weight of merchantable corn were both a little more than fifty per cent greater on the rows from which the tassels were removed than upon those upon which the tassels were left. This is not only true of the two sets of rows as a whole, but with the individual rows as well. In no case did a row upon which the tassels were left produce anywhere near as much as the tasselled rows on either side of it. In fact, the results given above are really the aggregate results of twenty-four distinct duplicate experiments, each of which alone showed the same thing as the aggregate of all.

By abortive ears is meant those sets that made only a bunch of husks, and sometimes a small cob, but no grain. It will be noticed that they were by far the most numerous on those rows from which the tassels were not removed. It will also be noticed that the total of the good, poor, and abortive ears is about fourteen per cent greater on the rows on which the tassels were left, while the weight of merchantable corn is more than fifty per cent greater on those rows from which the tassels were removed.

HEALTH MATTERS.

Action of an Infusion of Coffee on Bacteria.

IN studying the germicidal action of coffee, Dr. Luderitz made use of infusions of different degrees of concentration, varying from five to thirty grains of coffee to ten cubic centimetres of water. According to *The Sanitary News*, he mixed from four to six drops of pure culture-broth with eight to ten cubic centimetres of this infusion, and at the end of a certain time he withdrew parts of this mixture and cultivated them in gelatine. Experiment showed that the micrococcus prodigiosus dies in a ten-per-cent infusion of coffee in from three to five days, the bacillus of typhus in from one to three days, the proteus vulgaris in from two to four days, the staphylococcus aureus in from four to seven days, the streptococcus of erysipelas in one day, the bacillus of cholera in from three to four hours, the bacillus of anthrax in from two to three hours, and the spores of anthrax in from two to four weeks. In a thirty-per cent infusion of coffee the typhus bacillus dies in one day, the staphylococcus aureus in from one to three days, the bacillus of cholera in from half an hour to two hours, the bacillus of anthrax in two hours, the spores of anthrax in from two to four weeks. In a second series of experiments Luderitz studied the influence of an infusion of coffee mixed with gelatine on the development of bacteria. These experiments showed that the micrococcus prodigiosus does not vegetate in gelatine containing from three to nine per cent of coffee, the bacillus of typhus in gelatine with three per cent of coffee, the proteus vulgaris with from five to nine per cent, the staphylococcus aureus with two per cent, the streptococcus of erysipelas with one per cent, the cholera bacillus with one, and the bacillus of anthrax with 0.6 per cent. The action is the same for the different qualities of coffee, and is due, not to the caffeine, but to the products of the roasting of the coffee.

NOTES AND NEWS.

A FEW more points may be added to what was said on the Etruscan question in *Science*, Feb. 20, p. 99. M. Zanardelli has published, in the last volume of the *Bulletin de la Société d'Anthropologie de Bruxelles* (1890), a paper on the relationship of the Etruscan, Umbrian, and Oscan languages to the modern Italian. So far as the first-named goes, the resemblances are merely phonetic, as in the frequency of syllables ending in vowels. Professor Ferdinando Borsari of Naples has contributed to the last number of the *Rassegna Scientifica* à new study of the famous inscription of Menep phtah (of the nineteenth dynasty), in which the Etruscans, and, as he thinks, the Sicilians and Sardinians, are for the first time mentioned (*Etruschi, Sardi e Siculi nel* XIV° *Secolo prima dell'Era volgare*). He does not meet all the objections offered to these identifications, nor does he note the recent suggestions as to the interpretation of the inscription by Dr. Max Müller and others.

— From the annual report of the special committee of the American Society of Civil Engineers, on uniform standard time, we learn that the advantages of the 24 hour notation are beginning to be recognized in various branches of civil life. In hospitals, for example, to prevent mistakes by nurses in the administration of medicine, in recording temperatures, and in other matters, the new system is being gradually introduced; also in weather-tables and in the recording of meteorological readings: indeed, in departments where simplicity of system and accuracy are essential, the new notation is being spontaneously brought into use in many quarters. For two or three years back the Canadian Almanac has abandoned the old notation and substituted the new. It is in connection with railway service, however, that the general introduction of the 24-hour notation may mainly be looked for.

— The notion that the Welsh had in pre-Columbian times some knowledge of the American continent has for centuries found advocates, but never a competent critic. The latest is B F. de Costa, who reprints from the *New England Historical and Genealogical Register* of January, 1891, his article on "The Pre-Columbian Voyages of the Welsh to America." He complains that the accounts of the alleged voyages of the Welsh to America about 1170 have not received the attention they merit; but Mr. De Costa aids little to this end. The passages he quotes are at second-hand and translations, and are eminently vague. They tell us at most that some sea-rover Madoc (there were many Madocs) found land in the West, and settled there. But both the date of this occurrence, and any definite information as to the land, are wanting. Why not print the originals, with a discussion of their sources? We are the more inclined to require this from a writer who dares the misleading statement that "the ancient literature of the Welsh carries us back to a period before the Christian era."

— In the "Report of the Lightning-Rod Conference" (London and New York, Spon, 1882), on p. 62, we read, "On the 13th June, 1854, the 'Jupiter' was struck by lightning. The conductors were in place; that of the mainmast which was struck went 2 metres (6 feet 6 inches) into the sea, and had at its end a ball 2 kilos in weight. After being struck the conductor had disappeared and the pieces of it were scattered everywhere." Further on, the report states that "the 'Jupiter' received no damage." There are a large number of cases on record in which the conductor is reported as destroyed or even dissipated, and yet no damage (always with the proviso noted below) occurred to the buildings or ships to which the conductors were attached. Generally it is stated that this fortunate result was in spite of the de-

struction of the rod. Would it not be more logical, in consideration of what we know of the conservation of energy, to say that the saving of damage to the building was on account of the destruction of the rod? The editor of *Science* will be glad to receive and publish pertinent accounts of lightning-stroke, that this controversy may be cleared up. But it should be borne in mind that a dissipated rod can protect only such points as lie between horizontal planes passing through its upper and lower ends, since the electrical energy comes in horizontally from the dielectric around.

— During the months of July and August, 1891, the following-named courses of instruction will be given in the summer schools of Harvard University: Anglo-Saxon, English, German, French, chemistry (4 courses), botany, geology (3 courses), physics (2 courses), physiology and hygiene, field-engineering (2 courses), physical training, and also a course of about thirty lectures concerning the methods of instruction in the several departments in which these courses belong. All of the above-named courses, except the two advanced courses in geology and those in field-engineering, are given in the college buildings at Cambridge, and are open to both men and women. The course in physiology and hygiene is expressly designed to meet the needs of teachers in the public schools. For information concerning the summer instruction in medicine, application should be made to the dean of the Harvard Medical School, Boylston Street, Boston, Mass. For circulars describing each of the summer courses in detail, application should be made to the secretary of Harvard University, Cambridge, Mass.

— As various erroneous statements have been made with regard to Dr. Nansen's Arctic expedition, the London *Times* gives the following account of what has actually been arranged. Dr. Nansen's desire is to leave Norway in February, 1892, but it is doubtful whether the special vessel which is being built will be ready by that time. Outside of Norway, not a farthing has been contributed by any one. The expedition is purely Norwegian, and will remain so. The Norwegian Government contributed 200,000 kroner; King Oscar, 20,000; twelve private individuals (all Norwegians except one Englishman, who has lived in Christiania for many years), 90,000: in all, 310,000 kroner, equal to £17,200. That, Dr. Nansen believes, will be sufficient. The ship, of course, is being specially constructed for the peculiar conditions which exist between the New Siberian Islands and the Pole. Dr. Nansen will be accompanied by probably not more than eight young men, all as stalwart and strong in physique as himself, and all equally confident of success.

— It has been shown by Dr. Marcet, according to *Nature* of March 12, that different persons respire different volumes of air to furnish to the body the oxygen required, and to yield a given weight of carbonic acid. Thus, to produce one gram of carbonic acid, three persons were found to need, on an average, 9 29, 10.51, and 11.30 litres of air respectively. The first was 23 years of age, the third 60; and no doubt the less the air required for a given combustion, the better the conditions of respiration. The influence of food on formation of carbonic acid in the body begins in the first hour after a meal, and increases for two or three hours, the period of maximum respiration of CO_2 varying in this time. After a certain time, the weight of CO_2 expired decreases more rapidly than the required volumes of air decrease. The influence of local variations of air-pressure appears in less air being needed, for a given amount of CO_2, with low pressures than with high; but the degree of the influence varies in individuals.

— It may be well to call attention again to the Royal Society of New South Wales prizes for original researches. The prizes are for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects: to be sent in not later than May 1, 1892, on the iron-ore deposits of New South Wales, the society's medal and £25; on the effect which settlement in Australia has produced upon indigenous vegetation, especially the depasturing of sheep and cattle, the society's medal and £25; on the coals and coal-measures of Australasia, the society's medal and £25: to be sent in not later than May 1, 1893, upon the weapons, utensils, and manufactures of the aborigines of Australia and Tasmania, the society's medal and £25; on the effect of the Australian climate upon the physical development of the Australian-born population, the society's medal and £25; on the injuries occasioned by insect pests upon introduced trees, the society's medal and £25. The competition is in no way confined to members of the society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. The society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labor, but it is hoped that the honor will be regarded as a sufficient inducement and reward. All communications should be addressed to the honorary secretaries, 5 Elizabeth Street, Sydney, New South Wales.

— Some interesting remarks on squirrels are made by various writers in the *Zoölogist*. It is often said that squirrels are torpid during winter, but there is no really sound evidence for this view. Mr. Masefield, writing from Cheadle, Stafford, Eng , says (*Nature*, March 12), "I have seen squirrels abroad on fine days in, I think I may say, every one of the winter months ; and while pheasant-shooting near here on a sunny day (Jan. 6 last), which was about the middle of the most severe frost we have had for many years, with several inches of snow on the ground, I saw a squirrel jumping from tree to tree, before the beaters, in the most lively condition." Mr. Blagg, also writing from Cheadle, has "frequently seen squirrels abroad in the middle of the winter, when there has been deep snow on the ground and a keen frost in the air. I remember," he adds, "once seeing a squirrel abroad during a severe storm of sleet and rain in winter-time, and he appeared to be not at all inconvenienced by the rough weather." Mr. Blagg's idea is that the squirrel probably does sleep a good deal more in winter-time than in summer, as do many other wild animals, but that he has to be continually waking up and taking nourishment. The period of reproduction is unfavorable to the notion of an almost complete state of torpidity. The editor of the *Zoölogist* records that he has notes of "finding newly-born squirrels on March 21 (three young), April 9 (three young), April 26 (four young), and April 29 (two young). Those found at the end of March and beginning of April were naked and blind; those taken at the end of April were about three parts grown." According to the editor, "the old squirrels, in case of danger, remove the young from the nest, or 'drey,' to some hole in a tree, whither they carry them one by one in the mouth, just as a cat carries her kitten. One of the prettiest sights in the world is to see an old squirrel teaching a young one to jump."

— Professor Dubois of Berne, as we learn from *Nature* of March 12, has lately been studying the physiological action of electric currents and discharges; and he has some interesting observations on the human eye, which, it is known, has luminous sensations under the action of galvanic currents. Sudden variations of intensity, especially at making and breaking the circuit, produce such flashes. With a moistened plate at the nape of the neck, and a pad on the eye, a slight flash was distinctly perceived, even with a Leclanché cell of about 1.20 volts, and measuring in the galvanometer .04 of a milliampère. Raising the intensity to .5, the observer could tell which pole was applied to the eye. On the other hand, the retina responds much less readily to discharges from condensers or induction coils. Not till a capacity of 0.037 of a microfarad and a tension of 21 volts was reached was a true retinal flash perceived; and not even with 10 microfarads were the durable sensations characteristic of the two poles produced. The retina re-acts to quantity.

— A new quarterly journal is announced for publication by Macmillan & Co., *The Economic Journal*, issued under the auspices of the British Economic Association, a society which numbers among its members Professors R. M. Smith of Columbia, Taussig of Harvard, Alfred Marshall, Henry Sidgwick, and many others equally well known.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....$3.50 a year.
Great Britain and Europe..... 4.50 a year.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

UNIVERSITY EXTENSION AND THE UNIVERSITY OF THE FUTURE.[1]

I AM requested to furnish information with reference to the university extension movement in England. It will be desirable that side by side with the facts I should put the ideas of the movement, for, in matters like these, the ideas are the inspiration of the work; the ideas, moreover, are the same for all, whereas the detailed methods must vary with different localities. The idea of the movement is its soul: the practical working is no more than the body. But body and soul alike are subject to growth, and so it has been in the present case. The English university extension movement was in no sense a carefully planned scheme, put forward as a feat of institutional symmetry: it was the product of a simple purpose, pursued through many years, amid varying external conditions, in which each modification was suggested by circumstances, and tested by experience. And with the complexity of our operations our animating ideas have been striking deeper and growing bolder. Speaking, then, up to date, I would define the root idea of "university extension" in the following simple formula: university education for the whole nation organized on a basis of itinerant teachers.

But every clause in this defining formula will need explanation and defence.

The term "university extension" has no doubt grown up from the circumstance that the movement in England was started and directed by the universities, which have controlled its operations by precisely the same machinery by which they manage every other department of university business. I do not know that this is an essential feature of the movement. The London branch presents an example of a flourishing organization directed by a committee formed for the purpose, though this committee at present acts in concert with three universities. I can conceive the new type of education managed apart from any university superintendence, only I should look upon such severance as a far more serious evil for the universities than for the popular movement.

[1] The substances of addresses delivered before the Johns Hopkins and other university audiences, by Richard G. Moulton, A.M., of Cambridge University, England.

But I use the term "university education" for the further purpose of defining the type of instruction offered. It is thus distinguished from school education, being moulded to meet the wants of adults. It is distinguished from the technical training necessary for the higher handicrafts or for the learned professions. It is no doubt to the busy classes that the movement addresses itself; but we make no secret of the fact that our education will not help them in their business, except that, the mind not being built in water-tight compartments, it is impossible to stimulate one set of faculties without the stimulus re-acting upon all the rest. The education that is properly associated with universities is not to be regarded as leading up to any thing beyond, but is an end in itself, and applies to life as a whole. And the foundation for university extension is a change, subtle but clear, that may be seen to be coming over the attitude of the public mind to higher education, varying in intensity in different localities, but capable of being encouraged where it is least perceptible,—a change by which education is ceasing to be regarded as a thing proper to particular classes of society or particular periods of life, and is coming to be recognized as one of the permanent interests of life, side by side with such universal interests as religion and politics. For persons of leisure and means, such growing demand can be met by increased activity of the universities. University extension is to be the university of the busy.

My definition puts the hope of extending university education in this sense to the whole nation without exception. I am aware that to some minds such indiscriminate extension will seem like an educational communism, on a par with benevolent schemes for redistributing the wealth of society so as to give everybody a comfortable income all round; but it surely ought not to be necessary to explain that in proposing a universal system of education we are not meaning that what each individual draws from the system will be the same in all cases. In this, as in every other public benefit, that which each person draws from it must depend upon that which he brings to it. University extension may be conceived as a stream flowing from the high ground of universities through the length and breadth of the country. From this stream each individual helps himself according to his means and his needs: one takes but a cupful, another uses a bucket, a third claims to have a cistern to himself. Every one suits his own capacity, while our duty is to see that the stream is pure, and that it is kept running.

The truth is, that the wide-reaching purpose of university extension will seem visionary or practicable according to the conception formed of education, as to what in education is essential and what accidental. If I am asked whether I think of shop-assistants, porters, factory-hands, miners, dock or agricultural laborers, women with families and constant home duties, as classes of people who can be turned into economists, physicists, literary critics, art connoisseurs, I admit that I have no such idea; but I do believe, or rather, from my experience in England I know, that all such classes can be interested in economic, scientific, literary, and artistic questions; and I say boldly that to interest in intellectual pursuits is the essential of education, in comparison with which all other educational purposes must be called secondary. I do not consider that a child has been taught to read unless he has been made to like reading. I find it difficult to think of a man as having received a classical education if the man, however scholarly, leaves college with no interest in classical literature such as will lead him to go on reading for himself. In education the interest is the life.

If a system of instruction gives discipline, method, and even originating power, without rousing a lasting love for the subject studied, the whole process is but a mental galvanism, generating a delusive activity that ceases when the connection between instructor and pupil is broken off; but if a teacher makes it his first business to stir up an interest in the matter of study, the education becomes self-continuing when teacher and pupil have parted, and the subject becomes its own educator. If, then, it be conceded that the essence of education is to interest, does it not seem a soberly practical purpose that we should open up to the whole nation without exception an interest in intellectual pursuits?

I take my stand on the broad moral ground that every human being, from the highest to the lowest, has two sides to his life,— his work and his leisure. To be without work in life is selfishness and sloth; but, if a man or woman is so entangled in routine duties as never to command leisure, we have a right to say to such persons that they are leading an immoral life. Such an individual has no claim to the title of a working-man: he is a slave. It may be cruel circumstances that have thus absorbed him in business, but that does not alter the fact: slavery was a misfortune rather than a fault to those who suffered it; but, in any case, to be content with slavery is a crime. Once get society to recognize the duty of leisure, and there is immediately a scope for such institutions as university extension that exist for the purpose of giving intellectual interests for such leisure time. The movement is thus one of the greatest movements for the "raising of the masses." With a large section of the people there is, at the present moment, no conception of "rising" in life, except that of rising out of one social rank into another. This last is of course a perfectly legitimate ambition, but it is outside the present discussion. University extension knows nothing of social distinctions. It has to do with a far more important mode of "rising" in life,— that of rising in the rank to which a man happens to belong at the moment, whether it be the rank in which he started or any other. There is a saying that all men are equal after dinner; and it is true, that while, in the material wealth we seek in our working hours, equality is a chimera, yet in the intellectual pursuits that belong to leisure there is no bar to the equality of all, except the difference of individual capacity and desire. Macaulay tells of the Dutch farmers who worked in the fields all day, and at night read the Georgics in the original. Scotch and American universities are largely attended by students who have had to engage in menial duties all the summer in order to gain funds for their high education during the winter. And every university extension lecturer, highly trained specialist as he is, will testify how his work has continually brought him into contact with persons of the humblest social condition, whom a moment's conversation has made him recognize as his intellectual equals. No one has any difficulty in understanding that in religious intercourse and experience all classes stand upon an equality; and I have spoken of the foundation for the university extension movement as being the growing recognition of education as a permanent human interest akin to religion. The experience of a few years has sufficiently demonstrated the possibility of arousing such interest: to make it universal is no more than a practical question of time, money, and methods.

But no doubt when we come to *modus operandi* the main difficulty of the movement is the diversity of the classes it seeks to approach,— diversity in individual capacity, in leisure, means, and previous training. Opposite policies have been urged upon us. Some have said, "Whatever you do, you must never lower the standard. Let the extension movement present outside the universities precisely the same education as the universities themselves are giving, however long you may have to wait for its acceptance." On the other hand, it has been urged, "You must go first where you are most needed. Be content with a makeshift education until the people are ready for something better." The movement has accepted neither of these policies, but has made a distinction between two elements of university training,— method and curriculum. So far as method is concerned, we have considered that we are bound to be not less thorough, but more thorough, if possible, than the universities themselves, in proportion as our clients work under peculiar difficulties. But in the matter of curriculum we have felt it our first duty to be elastic, and to offer little or much, as may in each case be desired. Accordingly, we have elaborated an educational unit,— the three-months' course of instruction in a single subject. This unit course we have used all the resources we could command for making as thorough in method as possible. Where more than this is desired, we arrange that more in a combination or series of such unit courses. The instruction can thus be taken by retail or wholesale, but in all cases it must be administered on the same rigorous method.

The key to the whole system is thus the unit course of three months' instruction in a single subject. The method of such a course is conveyed by the technical terms "lecture," "syllabus," "exercises," "class." The lectures are addressed to audiences as miscellaneous as the congregation of a church or the people in a street car; and it is the duty of the teacher to attract such miscellaneous audiences, as well as to hold and instruct them. Those who do nothing more than simply attend the lectures will at least have gained the education of continuous interest. It is something to have one's attention kept upon the same subject for three months together. But it may be assumed that in every such audience there will be a nucleus of students, by which term we simply mean persons willing to do some work between one lecture and another. The lectures are delivered no oftener than once a week; for the idea is not that the lectures convey the actual instruction, a great part of which is better obtained from books, but the office of the lecture is to throw into prominence the salient points of the study, and rouse the hearers to read for themselves. The course of instruction is laid down in the syllabus,— a document of perhaps thirty or forty pages, sold for a trifling sum. By referring for details to the pages of books, this pamphlet can be made to serve as a text-book for the whole course, making the teacher independent in his order of exposition of any other text-book. The syllabus assists the general audience in following the lectures without the distraction of taking notes, and guides the reading and thinking of the students during the week. The syllabus contains a set of "exercises" on each lecture. These exercises, unlike examination questions or "quizzes," are not tests of memory, but are intended to train the student to work for himself. They are thus to be done under the freest conditions,— at home, with full leisure, and all possible access to books, notes, or help from other persons. The written answers are sent to the lecturer for marginal comment, and returned by him at the "class." This class is a second meeting for students and others, at which no formal lecture is given; but there is free talk on points suggested to the teacher by the exercises he has received. The usual experience is that it is more interesting than the lecture. This weekly

routine of lecture, syllabus-reading, exercise, and class goes on for a period of twelve weeks. There is then an "examination" in the work of the course held for students who desire to take it. Certificates are given by the university, but it is an important arrangement that these certificates are awarded jointly on the result of the weekly exercises and the final examination.

The subjects treated have been determined by the demand. Literature stands at the head in popularity; history, with economy, is but little behind. All the physical sciences have been freely asked for. Art constitutes a department of work; but it is art-appreciation, not art-production. The movement has no function to train artists, but to make audiences and visitors to art-galleries more intelligent. It will be observed that the great study known as "classics" is not mentioned in this list; but it is an instructive fact that a considerable number of the courses in literature have been on subjects of Greek and Latin literature treated in English, and some of these have been at once the most successful in numbers and the most technical in treatment. I am not without hope that our English university extension may re act upon our English universities, and correct the vicious conception of classical studies which gives to the great mass of university men a more or less scholarly hold upon ancient languages, without any interest whatever in ancient literatures.

This university extension method claims to be an advance on existing systems, partly because under no circumstances does it ever give lectures unaccompanied by a regular plan of reading and exercises for students. These exercises, moreover, are designed, not for mental drill, but for stimulus to original work. The association of students with a general audience is a gain to both parties. Many persons follow regularly the instruction of the class who have not participated in the exercises. Moreover, the students, by their connection with the popular audience, are saved from the academic bias which is the besetting sin of teachers: more human interest is drawn into the study. The same effect follows from the miscellaneous character of the students who contribute exercises. High university graduates, experts in special pursuits, deeply cultured individuals who have never before had any field in which to exhibit the fruits of their culture, as well as persons whose spelling and writing would pass muster nowhere else, or casual visitors from the world of business, or young men and women fresh from school, or even children writing in round text,— all these classes may be represented in a single week's work; and the papers sent in will vary in elaborateness from a scrawl on a post-card to a magazine article or treatise. I have received an exercise of such a character that the student considerately furnished me with an index. I remember one longer still, but, as this hailed from a lunatic-asylum, I will quote it only for illustrating the diversity of the spheres reached by the movement. Study participated in by such diverse classes cannot but have an all-roundness, which is to teachers and students one of the main attractions of the movement.

But we shall be expected to judge our system by results; and, so far as the unit courses are concerned, we have every reason to be satisfied. Very few persons fail in our final examinations; and yet examiners report that the standard in university extension is substantially the same as that in the universities, our pass students being on a par with pass men in the universities, our students of "distinction" reaching the standard of honors schools. Personally I attach high importance to results which can never be expressed in statistics. We are in a position to assert that a successful course perceptibly influences the tone of a locality for the period it lasts. Librarians volunteer reports of an entirely changed demand for books, and we have even assurances that the character of conversation at "five o'clock teas" has undergone marked alteration. I may be permitted an anecdote illustrating the impression made upon the universities themselves. I once heard a brilliant university lecturer, who had had occasional experience of extension teaching, describe a course of investigation which had interested him. With an eye to business, I asked him if he would not give it in an extension course. He became grave. "Well, no," he replied, "I have not thought it out sufficiently for that;" and when he saw my look of surprise, he added, "You know, any thing goes down in college; but when I have to face your mature classes, I must know my ground well." I believe the impression thus suggested is not uncommon among experts who really know the movement.

Our results are much less satisfactory when we turn to the other side of our system, and inquire as to curriculum. It must be admitted that the larger part of our local centres can only take unit courses. There may be often a considerable interval between one course and another; or, where courses are taken regularly, the necessity of meeting popular interest involves a distracting variety of subjects; while an appreciable portion of our energies have to be taken up with preliminary half-courses, rather intended to illustrate the working of the movement than as possessing any high educational value. The most important advance from the unit course is the affiliation system of Cambridge University. By this a town that becomes regularly affiliated has arranged for it a series of unit courses, put together upon proper sequence of educational topics, and covering some three or four years. Students satisfying the lecturers and examiners in this extended course are recognized as "students affiliated" (S.A.), and can at any time enter the university with the status of second year's men, the local work being accepted in place of one year's residence and study. Apart from this, the steps in our educational ladder other than the first are still in the stage of prophecy. But it is universally recognized that this drawback is a matter solely of funds. Once let the movement command endowment, and the localities will certainly demand the wider curriculum that the universities are only too anxious to supply.

The third point in our definition was that the movement was to be organized on a basis of itinerant teachers. This differentiates university extension from local colleges, from correspondence teaching, and from the systems of which Chautauqua is the type. The chief function of a university is to teach, and university extension must stand or fall with its teachers. It may or may not be desirable on other grounds to multiply universities; but there is no necessity for it on grounds of popular education, the itinerancy being a sufficient means of bringing any university into touch with the people as a whole. And the adoption of such a system seems to be a natural step in the evolution of universities. In the middle ages the whole body of those who sought a liberal education were to be found crowded into the limits of university towns, where alone were teachers to listen to, and manuscripts to copy. The population of such university centres then numbered hundreds where to-day it numbers tens. The first university extension was the invention of printing, which sent the books itinerating through the country, and reduced to a fraction the actual attendance at the university, while it vastly increased the circle of the educated. The time has now come to send teachers to follow the

books, the ideas of the university being circulated through the country as a whole, while residence at a university is reserved as the apex only of the university system.

An itinerancy implies central and local management, and travelling lecturers who connect the two. The central management is a university, or its equivalent. This is responsible for the educational side of the movement, and negotiates for the supply of its courses of instruction at a fixed price per course.[1] The local management may be in the hands of a committee formed for the purpose, or of some local institution — such as a scientific or literary club or institute — which may care to connect itself with the universities. On the local management devolves the raising funds for the university fee and for local expenses, as well as the duty of putting the advantages of the course offered before the local community. The widest diversity of practice prevails in reference to modes of raising funds. A considerable part of the cost will be met by the tickets of those attending the lectures, the prices of which I have known to vary from a shilling to a guinea for the unit course, while admission to single lectures has varied from a penny to half a crown. But all experience goes to show that only a part of this cost can be met in this way. Individual courses may bring in a handsome profit, but, taking account over various terms and various districts, we find that not more than two-thirds of the total cost will be covered by ticket-money. And even this is estimated on the assumption that no more than the unit course is aimed at; while even for this the choice of subjects, and the chance of continuity of subject from term to term, are seriously limited by the consideration of meeting cost as far as possible from fees. University extension is a system of higher education; and higher education has no market value, but needs the help of endowment. But the present age is no way behind past ages in the number of generous citizens it exhibits as ready to help good causes. The millionnaire who will take up university extension will leave a greater mark on the history of his country than even the pious founder of university scholarships and chairs; and, even if individuals fail us, we have the common purse of the public or the nation to fall back upon.

The itinerant lecturers, not less than the university and the local management, have responsibility for the progress of the cause. An extension lecturer must be something more than a good teacher, something more even than an attractive lecturer: he must be imbued with the ideas of the movement, and ever on the watch for opportunities of putting them forward. It is only the lecturer who can maintain in audiences the feeling that they are not simply receiving entertainment or instruction which they have paid for, but that they are taking part in a public work, and are responsible for giving their locality a worthy place in a national scheme of university education. The lecturer, again, must mediate between the local and the central management, always ready to assist local committees with suggestions from the experience of other places, and equally attentive to bringing the special wants of different centres before the university authorities. The movement is essentially a teaching movement, and it is to the body of teachers I look for the discovery of the further steps in the development of popular education. For such a purpose lecturers and directors alike must be imbued with the missionary spirit, for university extension is a missionary university, not content with supplying culture, but seeking to stimulate the demand for it. This is just the point in which education in the past has shown badly in comparison with religion or politics. When a man is touched with religious ideas, he seeks to make converts; when he has views on political questions, he agitates to make his views prevail. Culture, on the other hand, has been only too often cherished as a badge of exclusiveness, instead of the very consciousness of superior education being felt as a responsibility which could only be satisfied by efforts to educate others. To infuse a missionary spirit into culture is not the least purpose of university extension.

I cannot resist the temptation to carry forward this thought from the present into the future. In university extension so described, may we not see a germ for the university of the future? I have made the foundation of our movement the growing conception of education as a permanent interest of adult life side by side with religion and politics. The change is at best only beginning: it tasks the imagination to conceive all it will imply when it is complete. To me it appears that this expanding view of education is the third of the three great waves of change the succession of which has made up our modern history. There was a time when religion itself was identified with a particular class, the clergy alone thinking out what the rest of the nation simply accepted; then came the series of revolutions popularly summed up as the Reformation, by which the whole adult nation claimed to think for itself in matters of religion, and the special profession of the clergy became no more than a single element in the religious life of the nation. Again, there has been in the past a distinct governing class, to which the rest of society submitted, until a series of political revolutions lifted the whole adult population into self-government, using the services of political experts, but making public progress the interest of all. Before the more quiet changes of the present age, the conception of an isolated learned class is giving way before the ideal of a national culture, in which universities will still be centres for educational experts; while university extension offers liberal education to all, until educationally the whole adult population will be just as much within the university as politically the adult population is within the constitution. It would appear, then, that the university of such a future would be by no means a repetition of existing types, such as Oxford or Cambridge, Harvard or Johns Hopkins. These institutions would exist, and be more flourishing than ever, but they would all be merged in a wider "University of England," or "University of America;" and just as the state means the whole nation, acting in its political capacity through municipal or national institutions, so the university would mean the whole adult nation, acting in its educational capacity through whatever institutions might be found desirable. Such a university would never be chartered; no building could ever house it; no royal personage or President of the United States would ever be asked to inaugurate it. The very attempt to found it would imply misconception of its essential character. It would be no more than a floating aggregation of voluntary associations. Like the companies of which a nation's commerce is made up, such associations would not be organized, but would simply tend to co-operate because of their common object. Each association would have its local and its central side, formed for the purpose of mediating between the wants of a locality and the educational supply offered by universities or similar central institutions. No doubt such a scheme is widely different from the ideal education of European countries, so highly organized from above that the minister of education can look at his watch and know at any moment all that is being done

[1] The Cambridge fee is £45 per course of three months.

throughout the country. On the contrary, the genius of the Anglo-Saxon race leans towards self-help. It has been the mission of the race in the past to develop self-government in religion and politics: it remains to crown this work with the application of the voluntary system to liberal education.

In indulging this piece of speculation I have had a practical purpose before me. If what I have described be a reasonable forecast for the university of the future, does it not follow that university extension, as the germ of it, presents a field for the very highest academic ambition? To my mind, it appears that existing types of university have reached a point where further development in the same direction would mean decline. In English universities the ideal is "scholarship." Scholarship is a good thing, and we produce it. But the system which turns out a few good scholars every year passes over the heads of the great mass of university students without having awakened them to any intellectual life: the universities are scholarship-factories, producing good articles, but with a terrible waste of raw material. The other main type of university enthrones "research" as its *summum bonum*. Possibly research is as good a purpose as a man can set before him, but it is not the sole aim in life. And when one contemplates the band of recruits added each year to the army of investigators, and the choice of ever minuter fields — not to say lanes and alleys — of research, one is led to doubt whether research is not one of the disintegrating forces of society, and whether ever-increasing specialization must not mean a perpetual narrowing of human sympathies in the intellectual leaders of mankind. Both types of university appear to me to present the phenomena of a country suffering from the effects of over-production, where the energies of workers had been concentrated upon adding to the sum of wealth, and all too little attention had been given to the distribution of that wealth through the different ranks of the community. Just at this point the university extension movement appears to recall academic energy from production to distribution, suggesting that devotion to physics, economics, art, can be just as truly shown by raising new classes of the people to an interest in physical and economic and æsthetic pursuits as by adding to the discoveries of science, or increasing the mass of art products. To the young graduate, conscious that he has fairly mastered the teaching of the past, and that he has within him powers to make advances, I would suggest the question whether, even for the highest powers, there is any worthier field than to work through university extension towards the university of the future.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Souring of Milk during Thunder-Storms.

IN *Science* of Sept. 19, 1890, appeared a short note on some work recently done in Italy by Professor Tolomei on the souring of milk during thunder-storms. Professor Tolomei concludes that there is a sufficient amount of ozone generated at such times to coagulate milk by a process of direct oxidation, and a consequent production of lactic acid.[1]

Similar results have been obtained by other experimenters, and some have even gone so far as to say that free oxygen, when in contact with milk, will generate enough lactic acid to coagulate its caseine.

These results are very different from some obtained in this laboratory. While working on the bacteria in milk, the idea occurred to us to find out, if possible, the truth of the somewhat widely accepted theory that milk will sour with extreme rapidity during thunder-storms. Although the statement that this is an oxidizing action had been frequently made, a Mr. Iles of Baltimore was the first, so far as I know, to perform any experiments in this direction.[1] His method was to subject milk to the action of ozone, generated by an electric spark passed through oxygen, above the milk. He found a rapid coagulation produced, which he attributed to the direct oxidizing action of the ozone.

Our method was similar to that of Mr. Iles's. A Wolff bottle was filled about one-third full of milk, and the air in the bottle displaced by pure oxygen. Through the opposite necks wires leading from a Holtz induction machine were passed into the interior, and the necks plugged tightly with cotton to prevent any escape of oxygen; ozone was then generated by passing a spark across through the oxygen from one pole to the other. In some cases, instead of the spark, a "silent discharge" of electricity from the two poles was used to generate ozone.

In all cases a second bottle was partially filled with milk, and kept as a "control;" i.e., one in which the milk is left in its normal condition.

For some of our experiments three bottles were used, — one left as a control; a second filled with milk and oxygen; while a third was filled, like the second, with milk and oxygen, and then treated with the electricity. We thus had milk under three conditions: 1. In its normal state; 2. Under the influence of free oxygen; 3. Under the influence of free oxygen plus a certain amount of ozone. The electricity, in all cases, was passed through the oxygen for at least half an hour. That a considerable quantity of ozone was generated, was shown by its odor, and strong action on starch-iodine paper. Our results were very different from those given by Iles and Tolomei. The milk treated with ozone, or simply pure oxygen, soured a little, but only a little, faster than normal milk. If the milk in the control coagulated in thirty-six hours, the milk experimented on coagulated only an hour or two earlier.

This result was very constant. In a considerable number of experiments, using milk of all degrees of sweetness, from that just from the cow to that a day or more old, the same result followed, — a slight hastening of the time of coagulation in milk treated with ozone or oxygen. Between the time of coagulation of milk treated simply with oxygen, and that treated with oxygen plus ozone, no perceptible difference could be noticed.

We had, then, in our experiments, produced a slight hastening of the time of coagulation. Was this a direct oxidation? From the fact that it required over a day to act, it seemed likely that it could not be. If, however, it were an oxidation, it ought to act as well on sterilized milk — i.e., milk in which all bacteria have been killed by heat — as on ordinary milk. We therefore, before introducing the oxygen, sterilized the milk. In this case no coagulation occurred. Milk that had been treated at two separate times, a week apart, with oxygen and ozone, was kept for over two months without the appearance of the least sign of coagulation.

Briefly summed up, then, our results were as follows :—

1. Milk, under the influence of oxygen, or oxygen and ozone, coagulates somewhat earlier than when left in its normal condition.

2. This action does not take place if the milk has been sterilized, and is kept from contact with unfiltered air.

3. It is probably, therefore, not an oxidation. The conclusion drawn from this is that the souring was simply produced by an unusually rapid growth of bacteria. The bacteria of milk are mostly aerobic, and would undoubtedly be stimulated to rapid growth by free oxygen or ozone.

If in a thunder-storm ozone is set free, as some observers claim, its action on bacteria would perhaps explain the effects produced

[1] A more extended account of Professor Tolomei's experiments is given in *Biedermann's Central-Blatt für Agriculturchemie*, 1890, p. 538.

[1] Chemical News, vol. xxxvi. p. 237.

at such times. I am inclined to think, however, that a more probable reason is to be found in the general conditions of the atmosphere preceding and during the storm. It has been found in our laboratory that bacteria growing on gelatine will multiply with unusual rapidity during warm, sultry weather. Now, these are the atmospheric conditions that usually precede and accompany thunder-storms. It seems to me most likely, therefore, that whatever rapid souring occurs is due to an unusually rapid growth of bacteria, caused by especially favorable conditions of the atmosphere.

The experience of the proprietor of a neighboring creamery confirms to a certain extent these conclusions. He finds, that, if milk is kept at a uniformly low temperature during the thunder-storm season, no trouble results from rapid souring, indicating that this souring, when it occurs, is due more to a high temperature and sultry atmosphere than to the ozone in the air. If this were a process of direct oxidation, it should take place, partially at least, at the lower temperature.

Professor Tolomei finds, also, that a slight electric current, if less than three ampères, will have a preservative effect on milk, the current being passed directly through the liquid. A current greater than three ampères will decompose the milk.

In our experiments, a current of less than one-fortieth of an ampère was sufficient to produce decomposition, with a certain amount of coagulation at each electrode. A stronger current would produce complete coagulation, with the somewhat curious result that the coagulum was strongly acid at the positive pole, and more feebly alkaline at the negative pole.

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Middletown, Conn., March 20.

Mixed Races.

DR. F. VON LUSCHAN, in his description of the Tachtadschy (*Reisen in Lykien*, etc., Vienna, 1889), calls attention to the important fact that the Greeks of Lycia represent a mixture of two distinct types, and from these facts draws the following inference: "At first glance, it appears remarkable and hardly probable that two disparate types should remain distinct, although intermarriage has continued without interruption through thousands of years. But we must acknowledge that it would be just as remarkable if continued intercrossing should result in the production of a middle type (*Mischform*). It is true that at the present time the greater number of anthropologists appear to be of the opinion that middle forms originate wherever two distinct types live in close contact for a long time. If this is true at all, it is true only in a very limited sense, and still needs to be proven. *A priori*, we rather ought to expect that one or the other of these types would soon succumb in the struggle for existence. It would become extinct, and give way to the other type; or both types might continue to co-exist, although intercrossing might go on for centuries. They would undergo no other changes than those which each singly, uninfluenced by the other, would have undergone by the agency of physical causes." He exemplifies these opinions by statistical treatment of his cranial material, and by showing that in a single family all the extreme types which occur among the whole people are found.

Measurements of mixed Indian types give results which tally exactly with Dr. Von Luschan's views, and tend to support Kollmann's conclusions regarding the stability of cranial forms. The Bilqula (Bella Coola) of British Columbia are a mixed people, their language showing that they are of Salish affinity, while they have intermarried extensively with Athapascans and Haeltzukans. A study of the distribution of occurrence of length-width indices of their heads shows that the indices of from 79 to 81 are frequent, those about 83 rare, those of from 85 to 87 again very frequent. The first index corresponds to the most frequent one of the Haeltzukans; the last, to the most frequent one of the Athapascans of this region. If we consider the facial indices, a similar relation reveals itself. We find a greater frequency of the indices ranging about 79, a few cases ranging about 82, and many about 85. The height of body shows the same character of distribution, — a maximum about 160 centimetres, and another about 168 centimetres. If the three curves of frequency are drawn out, their correspondence is found to be so close that it cannot be due to mere accident. Other measurements do not show the same peculiarity, because those of the peoples of the coast do not differ materially from those of the peoples of the interior.

When these same curves are drawn out for the Oregonian Athapascans, it appears that the curves are also alike among themselves, while they differ fundamentally from those of the Bilqula. I give here a table of the length-width indices of the heads of the Oregonian Athapascans, Northern Californians, and crosses between the two, which will be found instructive: —

	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
Oregonian Athapascans	1	1	–	3	2	5	5	5	5	5	9	5	2	1	3	4	1
Crosses	–	–	1	–	1	1	–	–	–	–	1	–	1	–	1	–	–
Northern Californians	–	–	–	1	2	2	2	1	–	–	–	–	–	–	–	–	–

The first column shows particularly a much slower increase than we ought to expect if it represented a simple error curve; the second column shows a great variability, due to the presence of two distinct types. We see, notwithstanding the small number of cases, the maxima of the first and of the third columns clearly indicated. The asymmetry of the first column is easily explainable on the assumption of an intermixture with Californian tribes, and that therefore the indices peculiar to them occur more frequently.

On studying the single cases of these groups, it appears, that, although the characteristics of the component types become apparent by a statistical treatment of the series, they do not exist in the individual. The individuals are not representatives of one of the parent types, but mixed types; some parts of their bodies representing one type, other parts the other type. This mixture appears in a great variety of combinations. Middle types, that is, those standing between the two parent types, if found at all, are very few in number.

FRANZ BOAS.

Clark University, Worcester, Mass., March 17.

BOOK-REVIEWS.

Outlines of Psychology. By HARALD HÖFFDING. Tr. by Mary E. Lowndes. New York, Macmillan. 12°. $1.50.

THE translation of this work has not been made from the original Danish, but from the German translation. Professor Höffding, however, considers the German version a correct and adequate representation of the original, so that English readers can here obtain an accurate account of his views. The English version is natural and easy, and the author's meaning is, as a rule, plain and intelligible. The work is written with ability, and gives evidence of prolonged study of the subject in all its departments. It opens with some account of the scope and method of psychology, followed by a chapter on the relations of mind and body, and then takes up in succession the three fundamental elements of mental life, — cognition, feeling, and will, — the first of them naturally receiving the principal share of attention. The work is designed as a manual for students; but for that purpose the arrangement is bad, since the earlier chapters can hardly be understood without some previous knowledge of both psychology and philosophy. The plainness of the author's style, however, serves partly to remove this difficulty.

As regards the substance of the work, our judgment must be rather unfavorable. Professor Höffding's philosophical standpoint is that of the association school, modified somewhat by evolutionism, yet not differing essentially from that of the English writers with whom we are familiar. He attempts, indeed, to treat his subject without reference to philosophical theories, stating at the outset that psychology is a purely empirical science in no way dependent on metaphysics; yet he is not able to adhere to this position, but drops into philosophical discussion at intervals

throughout his book. In discussing the relations of mind and body, he rejects both spiritualism and materialism, and maintains the doctrine that matter and spirit are the two aspects of some third entity different from either; yet he is obliged to confess that no such third substance is known to us, so that the assumption of its existence seems to be only a way of evading a difficulty. In dealing with ideas and feelings, he endeavors, like other associationists, to derive them all from sensation; but, as the more important of them refuse to lend themselves to this interpretation, he is obliged to assume a "mental chemistry" by which sensations are transmuted into something radically different from themselves. Yet he gives no proof that any such transmutation ever takes place, so that this theory also is merely a way of evading a problem which the association principle cannot solve. In spite, however, of his predilection for the association principle, he is not able to adhere to it rigidly, but adopts some views that are inconsistent with it. This is specially apparent in his account of our notion of space, which he thinks cannot be explained by sensation and association; so that, after discussing the various theories, he ends by adopting one not essentially different from that of Kant. In short, Professor Höffding's work reflects the present unsettled and sceptical state of philosophy; and it is safe to say that such a work could not have been written thirty years ago, and that no such work will be written thirty years hence. Nevertheless, there is much in it that students of the subject will like to read, and it will doubtless stimulate thought in many who disagree with its conclusions.

Chapters on the Theory and History of Banking. By CHARLES F. DUNBAR. New York, Putnam. 12°. $1.25.

THIS is an excellent book. It was originally prepared as a course of lectures to college students, and throughout the work the wants of beginners are kept in mind. Yet it is by no means confined to the mere rudiments of the subject, but contains about all the information that most readers will require. Professor Dunbar begins with the simplest cases of deposit and discount, and then proceeds to explain all the operations commonly carried on by banks, including the various kinds of loans and the issue of notes; and he succeeds in making the subject plainer than we have ever seen it made before. He devotes some space to showing the real character of the transaction known as discounting bills, and also points out the analogies that exist between notes and deposits. Numerous brief examples of banking accounts make the subject more intelligible; and the student who uses this book faithfully can hardly fail to get a good general idea of the nature and operations of a bank. After the descriptive and theoretical passages come several chapters on the history of banking, beginning with the Bank of Amsterdam, and tracing the outlines of the subject to the present day. The Banks of England, France, and Germany, with the peculiarities of each, are described, and

special attention is given throughout the book to the national banking system of the United States. The book cannot fail to be useful, not only to students, but also to men of business who wish to understand the methods of banking without being practically engaged in the work.

The French Invasion of Ireland in '98. By VALERIAN GRIBAYEDOFF. New York, Truth Seeker Company. 8°. $1.50.

THIS interesting work is not only a strong "side-light" on the times, persons, and places of which it treats, but also an important footnote to the history of Europe. It is well written and easily read; and the many authorities quoted or referred to prove that there was no lack of material from which to compile a truthful narrative of one of the many extraordinary episodes of the French Revolution. The greater events taking place at the time, Bonaparte and his doings then furnishing more than ample material for historians, crowded out or overshadowed the fact that Gen. Humbert, with a handful of French soldiers (little more than a thousand), penetrated to the heart of Ireland, held his own for several weeks against vastly superior numbers, and conquered an entire province before he was finally compelled to surrender to overwhelming odds. And the reasons why the apparently quixotic expedition failed of its purpose, or at least did not achieve a greater measure of success, are apparent to all who peruse this narrative, and at the same time consider the course of recent events in Ireland and the erratic actions of some of the present leaders in Irish political affairs.

The interest in the stirring events narrated in this volume will be enhanced by the fact that the commander of the expedition, Gen. Humbert, afterwards became an American citizen, served with honor in the war of 1812, and distinguished himself at the battle of New Orleans, where, by one of the coincidences of warfare, he found himself opposed to some of the English officers who had contributed to his defeat in Ireland.